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## **Drones Provide New Tool for Marine Mammal Research**

Studying whales and seals will not be the same for NEFSC marine mammal researchers Lisa Conger and Elizabeth Josephson, who have spent months training to fly an unmanned aerial system (UAS), commonly called a drone. Both researchers are now certified NOAA UAS pilots.

This spring they had a chance to put that training to good use. Operating from a NOAA small boat in Cape Cod Bay, they flew one of the NEFSC's research drones, an APH-22 hexacopter, in late April for right whale photo identification and photogrammetry studies. Photogrammetry techniques allow researchers to get body measurements from aerial photographs.

North Atlantic right whale mother and calf pairs and individual whales were photographed and identified during multiple flights a day. Each flight can last 15 to 20 minutes. Poor weather, and the early departure of whales from Cape Cod Bay, cut the researchers' days at sea and the opportunity for more flights short. But during those three days they took hundreds of images and have data to work with in the coming months.

"We are excited about aerial images of the whales from this enhanced perspective," said Conger, a marine mammal researcher in the NEFSC's Protected Species Branch. She studies North Atlantic right whales in the winter off Florida and Georgia where they calve and in the spring and summer in Cape Cod Bay and the Bay of Fundy where they feed.

"This technology opens up a lot of possibilities for whale researchers. Length and girth ratios will provide indications about health, and could serve as a long-term method of monitoring health," Conger said. "It could also help determine calf growth rates and contribute to behavioral studies."

Conger often studies whales from NOAA research vessels, sometimes using high powered binoculars called "Big Eyes" to locate whales. When weather allows, a small boat is deployed to capture a necessary suite of photographs, which will now include aeriels from the hexacopter.

Imagery from conventional airplanes will not be replaced by the UAS work. These planes are able to cover vast amounts of offshore area in a day. The NOAA Twin Otter aircraft used by the NEFSC's Protected Species Branch (PSB) for aerial surveys covers offshore waters from New York northward to Canada, and sometimes into Canadian waters. PSB's right whale aerial survey team flies in the Twin Otter on good weather days for seven to nine months out of the year.

“I’ve spent many years looking at right whales, but using drones adds a dimension which will help us gain new information,” Conger said. “The flight time we got with the APH-22 this spring, as well as learning to operate from a small vessel, have given us a great foundation to move forward. We’ve learned a lot and plan to incorporate the hexacopter into upcoming field work.”

Josephson already had some flying time, having first piloted the APH-22 in January 2016 during gray seal pupping studies on Muskeget Island off Nantucket. As part of that project, two other types of aircraft were flown over the island on the same day. The second platform was a fixed wing drone, the eBee, operated by Duke University. The third platform was a manned aircraft, the NOAA Twin Otter, which was outfitted with a belly camera for photogrammetry images. The three platforms are being evaluated to assess which technology is most appropriate for different situations.

## **Training required**

In order to fly an unmanned aerial system, NOAA Fisheries researchers must attend a week-long training session at the Southwest Fisheries Science Center in La Jolla, California. The training is co-taught by Wayne Perryman, who has developed aerial photogrammetry techniques over the past few decades for studies of marine mammals, and Don LeRoi of Aerial Imaging Systems, who developed and builds all of the APH-22s. The prospective pilots must also pass a FAA class II medical examination and the FAA private pilot ground school test to become certified NOAA UAS pilots. The whole process takes months and requires a lot of paperwork.

For each project, the operators must submit a flight request form and operational risk management plan to NOAA’s Office of Aviation Operations, based in Tampa, Florida, detailing what they intend to do and where. NOAA has a memorandum of understanding with the FAA for UAS operations. All flights are limited to a maximum altitude of 400 feet and must be within line of sight. NEFSC’s UAS research on marine mammals is authorized under the Marine Mammal Protection Act and Endangered Species Act by scientific research permit #177355-01 issued by the NMFS permitting office.

Conger and Josephson are two of four NEFSC staff currently certified to fly drones. Mike Jech and Jennifer Johnson of the Ecosystems Surveys Branch are also UAS pilots. They use images from the drones for tuna and menhaden studies related to their acoustic work. Jech was the first NEFSC staff member to become certified and is the Center’s point of contact for drone operations. Johnson was very helpful to Conger and Josephson in beginning their work with drones, which were first acquired for Jech’s tuna study. The two identical NEFSC hexacopters are nicknamed Ginger and Wasabi.

The APH-22 hexacopter is not your average off the shelf drone, either in capabilities or cost. With six rotors, it carries sensitive instruments and a digital camera, and has sophisticated calibration systems linked to its ground station that are geared toward research needs. Lightweight sampling systems or instruments can be added to it. The hexacopters, which can cost \$35,000 each, are built by Aerial Imaging Solutions in Connecticut.

## **Collaborative Projects**

Other local researchers are also using hexacopters and other UAS for marine animal research. The NOAA UAS program has collaborated with the Center's PSB sea turtle program led by Heather Haas for surveys from NOAA's Fisheries survey vessel (FSV) *Henry B. Bigelow*.

In addition, the NEFCS's Large Whale Team lead Peter Corkeron recently funded a research project using the APH-22 at Woods Hole Oceanographic Institution (WHOI) through NOAA's Cooperative Institute for the North Atlantic Region (CINAR). NOAA Fisheries marine mammal researchers John Durban and Holly Fearnbach from the Southwest Fisheries Science Center worked with WHOI biologist Michael Moore on a study including the "blow," the spray they make when exhaling, from right whales in Cape Cod Bay. Conger and Josephson are collaborators on the project.

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Related links:

NOAA Media Briefing July 14: Extending the Reach of Science with Unmanned Aircraft and Watercraft:

<http://www.noaa.gov/briefing-transforming-science-unmanned-systems>

North Atlantic right whales: <http://www.nmfs.noaa.gov/pr/species/mammals/whales/north-atlantic-right-whale.html>

North Atlantic right whale calf found dead off Chatham:

<https://www.bostonglobe.com/metro/2016/05/06/whale/M7Un0PdWxZFTLapC2BR2EP/story.html>

Drones and Field Sampling Document Gray Seal Pups on Muskeget and Monomoy Islands:

[http://www.nefsc.noaa.gov/press\\_release/pr2016/scispot/ss1602/](http://www.nefsc.noaa.gov/press_release/pr2016/scispot/ss1602/)

Endangered Whales Get a High-Tech Check-up: <http://www.whoi.edu/oceanus/feature/whales-and-drones>

Unmanned Aerial Systems Research at SWFSC:

<https://swfsc.noaa.gov/textblock.aspx?Division=PRD&ParentMenuId=211&id=18412>